RES

PATENT SPECIFICATION

799,039

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International Classification :—**B01j. C07c.**

COMPLETE SPECIFICATION.

Apparatus for Reactions involving Gases and/or Liquids.

We, THOMAS HEDLEY & CO. LIMITED, a British Company, of Phoenix Buildings, Collingwood Street, Newcastle upon Tyne 1, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention relates to apparatus for carrying out in a continuous manner chemical reactions in which the reactants are liquids or gases and liquids.

One object of the invention is to provide apparatus which produces intense turbulence and mixing of the reactants to ensure that rapid reaction takes place.

Another object is to provide such apparatus which ensures rapid removal of heat from the reaction zone in the case of exothermic reactions, or supply of heat in the case of endothermic reactions, so that control of reaction temperature is possible. This may be of special importance where one of the reactants or products is susceptible to deterioration as a result of local overheating.

According to the present invention, an apparatus for carrying out in a continuous manner chemical reactions involving liquids, or liquids and gases, comprises a stator and a rotor mounted on coincident or parallel axes and defining a reaction chamber therebetween of a cross section formed as a non-uniform annulus, blades so formed and mounted on either the stator or rotor as to extend across the reaction chamber and maintain contact with the rotor or stator correspondingly, thus dividing the reaction chamber into compartments which increase and decrease in volume as the rotor is rotated, and means establishing restricted communication between adjacent compartments of the reaction chamber. Such restricted communication is preferably established by perforations in the blades.

The stator may be in the form of a shell within which is a cylindrical rotor mounted on a coincident or parallel axis, the blades being mounted on the rotor to extend across the reaction chamber to contact the shell wall, so that, as the rotor is rotated, the compartments increase and decrease in volume.

Preferably the stator shell is circular in cross-section and the rotor axis is offset with respect to the stator axis.

As stated above the blades are preferably provided on the rotor when this is within the stator and is circular in cross-section : if, however, the rotor is of other cross sectional shape, for example elliptical and its axis is coincident with that of the stator, the blades are preferably provided on the stator surrounding the rotor.

The blades may either be hinged or slidably mounted on the stator or rotor, so that the further edges of the blades are in constant contact with the rotor or stator, respectively, thus serving to scrape the rotor or stator wall as the rotor is rotated.

The reactants may be admitted to the chamber either through ports in the stator or through ports in the rotor shaft, there being preferably a fan adjacent to the inlet ports for dispersing into the reaction chamber any reactant substances passing through the inlet. The apparatus is provided with suitable outlet ports through which the reaction products may be withdrawn.

There may be provided a centrifugal separator which is advantageously driven from the rotor shaft.

The stator and/or the rotor may be provided with heating or cooling means.

One embodiment of the apparatus of the invention is described below with reference

to the drawing accompanying the Provisional Specification in which :—

Figure 1 shows a section in elevation of the apparatus on the plane defined by the axes of the rotor and the stator, and

Figure 2 shows a plan section of the apparatus on the line X—X in Figure 1.

This particular embodiment of the apparatus is described with reference to its use for carrying out, in a continuous manner, the treatment of alkyl benzene with a mixture of sulphur trioxide vapour in air for the production of sulphonated alkyl benzene in detergent manufacture as described in our British Specification No. 27019/55 (Serial No. 799,038). The apparatus is constructed of acid resistant material such as stainless steel.

A cylindrical rotor A rotates on a driven shaft inside a cylindrical stator shell B. The axis of rotation of the rotor is eccentric with respect to the stator. The annular space between the rotor and stator is swept by longitudinal blades C which are hinged to the rotor in such a way as to allow the edges of the blades to maintain constant contact with the shell of the stator. Springs may be incorporated to ensure this contact. The shell is jacketed as shown at J to allow cooling of the reaction zone.

A mixture of air and sulphur trioxide vapour is supplied continuously to the reaction zone by means of the ports F which are spaced along the length of the reactor. Alkyl benzene is supplied to the inlet D and is dispersed by means of radial blades E mounted on the end of the rotor. The pumps supplying alkyl benzene and sulphur trioxide are proportioning pumps geared together so that the ratio of the rate of flow of sulphur trioxide to that of alkyl benzene is maintained constant. The degree of turbulence and intimacy of mixing of liquid and gaseous reactants is dependent on the speed of the rotor, the eccentricity of the rotor with respect to the shell, the number of blades and the number of holes in the blades.

From the reaction zone, the reaction mixture passes to a centrifugal disc separator G driven by the same shaft as drives the rotor A. The liquid components of the reaction mixture are separated at the separator G and are taken off at the outlet port H to be sent to the neutralisation stage. The separated gas is drawn off and may be passed through another separator to remove entrained liquid spray before being recycled to a sulphur trioxide vaporizer.

WHAT WE CLAIM IS :—

1. Apparatus for carrying out in a continuous manner chemical reactions involving liquids or liquids and gases, comprising a stator and a rotor mounted on coincident or parallel axes and defining a reaction chamber therebetween of a cross-section formed as an annulus of varying width, blades so formed and mounted on either the stator or rotor as to extend across the reaction chamber and maintain contact with the rotor or stator respectively, thus dividing the reaction chamber into compartments which increase and decrease in volume as the rotor is rotated, and means establishing restricted communication between adjacent compartments of the reaction chamber.

2. An apparatus according to Claim 1 wherein the stator is a jacketed cylindrical shell of circular cross-section within which is mounted the rotor which is also cylindrical and of circular cross-section, the axes of the rotor and the stator being parallel to and offset from each other.

3. An apparatus according to Claim 1 or 2, wherein the rotor carries the blades.

4. An apparatus according to Claim 3, wherein the blades are hinged to the rotor.

5. An apparatus according to Claim 3, wherein the blades are slidably mounted in slots in the rotor.

6. An apparatus according to any of the preceding claims, wherein each blade is provided with a number of apertures to provide the said means for establishing restricted communication between the adjacent compartments of the reaction chamber.

7. An apparatus according to any of the preceding claims, wherein the stator has an inlet for at least some of the reactant substances at one end, and an outlet for the products at the other end.

8. An apparatus according to Claim 7, wherein there is provided adjacent the inlet a fan for dispersing into the reaction chamber any reactant substances passing through the inlet.

9. An apparatus according to Claim 8, wherein the fan is driven by the rotor shaft.

10. An apparatus according to any of the preceding claims, wherein there are ports along the length of the reaction chamber for feeding in at least some of the reactant substances.

11. An apparatus according to any of the preceding claims, wherein a centrifugal separator is provided adjacent the outlet to the reaction chamber, and is driven by the rotor shaft.

12. An apparatus substantially as hereinbefore described with particular reference to the drawing accompanying the Provisional Specification.

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PROVISIONAL SPECIFICATION.

Apparatus for Reactions involving Gases and/or Liquids.

We, THOMAS HEDLEY & CO. LIMITED, a British Company, of Phoenix Buildings, Collingwood Street, Newcastle upon Tyne 1, England, do hereby declare this invention to be described in the following statement :—

This invention relates to apparatus for carrying out in a continuous manner chemical reactions in which the reactants are liquids or gases and liquids.

One object of the invention is to provide apparatus which produces intense turbulence and mixing of the reactants to ensure that the reaction takes place in the minimum time.

Another object is to provide such apparatus which ensures rapid removal of heat from the reaction zone in the case of exothermic reactions, or supply of heat in the case of endothermic reactions, so that control of reaction temperature is possible which may be of special importance where one of the reactants or products is susceptible to deterioration as a result of local overheating.

According to the present invention, apparatus for carrying out in a continuous manner chemical reactions involving liquids or liquids and gases comprises a stator and a rotor mounted on coincident or parallel axes and defining a reaction chamber therebetween of a cross section formed as a non-uniform annulus, blades so formed and mounted on either the stator or rotor as to extend across the reaction chamber and maintain contact with the rotor or stator correspondingly, thus dividing the reaction chamber into compartments, which increase and decrease in volume as the rotor is rotated, and means establishing restricted communication between adjacent compartments of the reaction chamber. Such restricted communication is preferably established by perforations in the blades.

The stator may be in the form of a shell within which is a cylindrical rotor mounted on a coincident or parallel axis, the blades being mounted on the rotor to extend across the reaction chamber to contact the shell wall, so that, as the rotor is rotated, the compartments increase and decrease in volume.

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The blades may either be hinged or slidably mounted on the stator or rotor, so that the outside edges of the blades are in constant contact with the rotor or stator, thus serving to scrape the rotor or stator wall as the rotor is rotated.

The reactants may be admitted to the chamber either through ports in the stator or through ports in the rotor shaft. The apparatus is provided with suitable outlet ports through which the reaction product may be withdrawn.

There may be provided a centrifugal separator which is driven from the rotor shaft.

The shell and/or the rotor may be provided with heating or cooling means.

One example of the apparatus of the invention is described below with reference to the accompanying drawing in which :—

Figure 1 shows a section of elevation of the apparatus on the plane defined by the axes of the rotor and the shell, and

Figure 2 shows a horizontal section of the apparatus on the line X—X in Figure 1.

This particular embodiment of the apparatus is described with reference to its use for carrying out, in a continuous manner, the treatment of alkyl benzene with a mixture of sulphur trioxide vapour in air for the production of sulphonated alkyl benzene in detergent manufacture as described in our copending Application No. 27019/55 (Serial No. 799,038). The apparatus is constructed of acid resistant material such as stainless steel.

A cylindrical rotor A rotates inside a cylindrical stator shell B. The axis of rotation of the rotor is eccentric with respect to the stator. The annular space between the rotor and stator is swept by longitudinal blades C which are hinged to the rotor in such a way as to allow the edges of the blades to maintain constant contact with the shell of the stator. Springs may be incorporated to ensure this contact. The shell is jacketed as shown at J to allow cooling of the reaction zone.

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and intimacy of mixing of liquid and gaseous reactants is dependent on the speed of the rotor, the eccentricity of the rotor with respect to the shell, the number of blades and the number of holes in the blades.

From the reaction zone, the reaction mixture passes to a centrifugal disc separator G where the liquid components of the reaction mixture are separated and taken off at the port H to be sent to the neutralization stage. The separated air is drawn off and may be passed through another separator to remove entrained liquid spray before being recycled to the sulphur trioxide vaporizer.

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799,039 PROVISIONAL SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale.

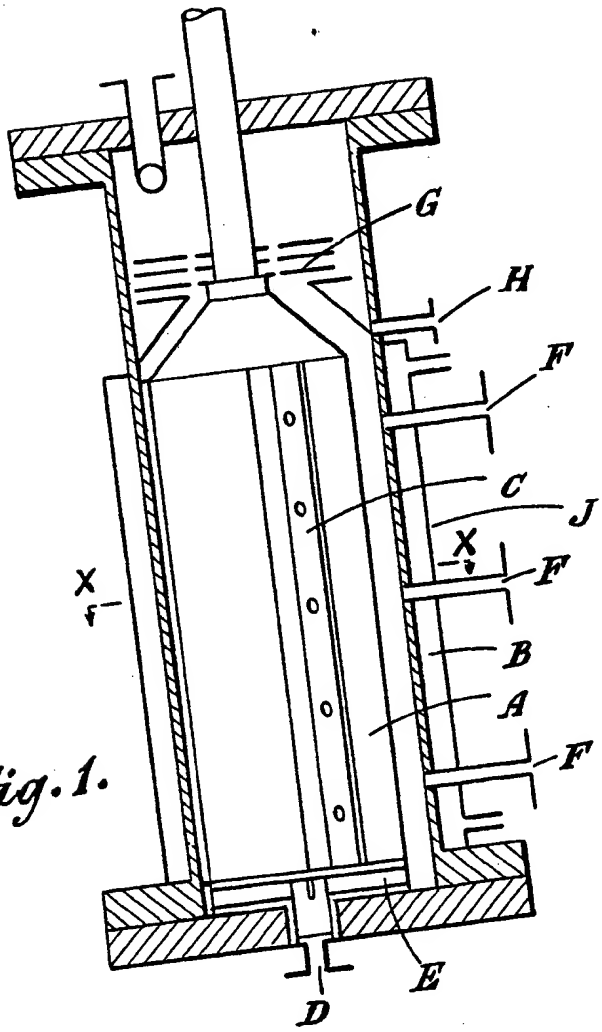

Fig. 1.

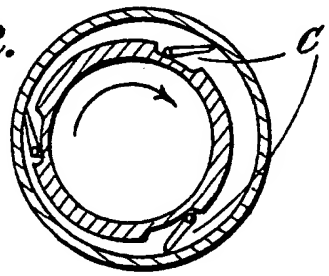

Fig. 2.